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MEMOIR

ALTGELD HALL STACKS

ON

A NEW KIND OF

MOVABLE DAM.

BY

S. JANICKI, Engineer,

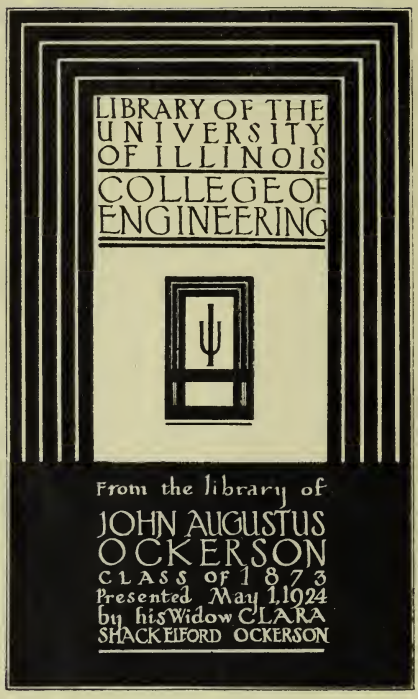
DIRECTOR OF THE MOSKVA NAVIGATION COMPANY.

TRANSLATED BY

LIEUT. COL. WILLIAM E. MERRILL,

CORPS OF ENGINEERS, U. S. A.

WASHINGTON:
1883.



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United States Engineer Office,

Cincinnati, O., September 24, 1883.

General:

In order to keep up with the latest improvements in movable dams, I have the honor herewith to forward a translation of a recent pamphlet by the Russian Engineer Janicki, which I think merits reproduction, although no dams have yet been built on the system which he has invented.

Respectfully, your obedient servant,

Wm. E. Merrill,

Lt. Col. Engineers.

Brig. Gen. H. G. Wright,

Chief of Engineers, U. S. A.

A NEW SYSTEM OF MOVABLE DAMS WITH HORSES.

By S. Janicki,

Director of the Moskva Navigation Company.

In order to point out the advantages of the new kind of movable dam which I have invented, I will first briefly recall the principal systems thus far used for such dams.

This review, while pointing out the successive modifications of existing types, will at the same time serve to prove that the new system under discussion contains nothing which is wholly new, and that it is in fact only a combination of parts belonging to types already known and approved by experience.

We believe that by this discussion we shall allay a certain legitimate timidity felt by practical engineers at applying on a large scale a system which in its novel combinations has nowhere yet been tested.

The first movable apparatus, employed to increase the height of water above fixed dams, consisted of wickets, or shutters, with horizontal axes of rotation *normal* to the thread of the stream, placed at the lower ends of these shutters.

To allow floods to pass, these shutters were dropped horizontally down-stream; when lifted, to raise the water-level, they were supported behind by props abutting against the down-stream slope of the dam.

This primitive type is very ancient; we find the earliest description of it in the work of DeLalande, published in 1778, (*Traité des Travaux de Navigation*), in which reference is made to such a movable dam on the river Orb.

Various modifications of this primitive type were afterwards made. In France, between 1832 and 1836, M. Thénard built a dam with similar movable shutters on the weir of the river Isle, with this difference, that in front of the principal shutters, which fall, as we have just stated, down-stream, he placed, at the suggestion of M. Mesnager, a first rank of similar shutters which fell up-stream. These are called counter-shutters.

This first rank of auxiliary up-stream shutters supported the water pressure, when upright, by means of tie rods or chains fastened to the upper slope of the dam; the object of this rank was to facilitate the setting up of the main shutters. In fact, when the movable dam had to be raised against a strong current, the auxiliary shutters (the counter-shutters) were released from their horizontal position and were righted by the mere force of the current. Under the shelter of this first rank, the principal shutters could be raised. This was done by the men in charge of the dam, who walked on the lower slope and put into place the feet of the props. As soon as the pressure of water created by the first rank was transferred to the principal rank of shutters, well braced by their props, the first (auxiliary) rank was laid down, so that it might be used again at the next raising of the dam.

To open dams of this kind while under pressure, the feet of the props were pushed by a side thrust away from the shoulders or sockets against which they rested. To assist in this somewhat awkward operation, and to save the men in charge from the necessity of getting upon the lower slope of the dam, M. Thénard introduced on the Orb dam another improvement, a notched bar, which engaged the feet of the props and enabled them to be dropped in succession. This notched bar is the *tripper*, which is still used for lowering the shutters or wickets of dams of the type, of which I shall speak further on, bearing the name of M. Chanoine.

The system which we have just described, and which is named after M. Thénard, was gradually improved by him, and was applied to the highest lifts. M. Thénard endeavored to place on the tops of the counter-shutters a narrow foot-walk, upon which the men whose duty it was to raise the lower shutters could stand. Finally, in order to get rid of the counter-shutters, he proposed to place above the rank of principal shutters a needle-dam on the Poirée system, whose closure by needles would permit the easy raising of the rank of shutters. This needle-dam was also to act as a service-bridge, upon which the men could walk who were to raise the lower shutters. In this way the manœuvring of the dam could be accomplished with ease and safety. But experience has proved that with the increase in the heights of shutters, and in the size of the rivers on which it was desired to use this system, its practical application became more and more difficult. The raising of the counter-shutters by the current cannot but cause very heavy shocks, which are dangerous to the anchorage of these counter-shutters; similarly, the raising of the principal shutters was difficult and dangerous. Since in France they were seeking to apply movable apparatus, not only for the purpose of increasing the heights of weirs, but also for closing navigable channels, which required shutters of great height, the system of MM. Thénard and Mesnager fell into disuse; that of M. Chanoine took its place. We should add, however, that the Thénard-Mesnager system, with various modifications of detail, is still used with considerable success by English engineers in the movable parts of the great dams on the rivers of India. (See *Movable Dams in Indian Weirs by Robert Buckley, Minutes of Proceedings of the Institution of Civil Engineers, Vol. IX., Session 1879–'80, part II.*). They have used on these Indian dams the shutters and counter-shutters of MM. Thénard and Mesnager up to pressures of more than 10 feet. In the Indian dams it is easy to close shutters and counter-shutters of this system when there is from 8 to 10 feet of water on the sills of the dams. They are opened rapidly and easily, but the arrangements are such as to require the insertion in the dam of masonry piers with open spaces between them not greater than from 20 to 50 feet.

The existence of permanent piers so close together, besides increasing the cost of building such dams, is a hindrance to free navigation. For this general reason, and more especially when we have to deal with rivers which freeze and are subject to ice-floods, the methods, which have been elaborated on the English East Indian rivers, cannot be applied in other countries. As we have seen above, it is especially the difficulty of raising the shutters against the current which has been the

chief cause for the abandonment in France of the Thénard-Mesnager system.

M. Chanoine, in order to avoid this difficulty, concluded to change the position of the axis of rotation of the shutters. This axis was placed by M. Chanoine, not immediately on the floor at the foot of the shutter, but at its centre (or a little below it), on the head of a horse which, in its turn, could rotate around a base fastened to the floor. This well known arrangement (I do not intend to describe it in detail here) permitted the shutter to be raised by pulling on its base. The shutter thus remained on the swing while coming up, and did not give the current too much hold.

By placing the axis of rotation of the wickets at about one-third their height, they could be rendered automatic; that is, they would swing of themselves when the upper level exceeded the prescribed height.

The wickets of M. Chanoine's system are lowered by means of the tripper, invented, as we have seen above, by M. Thénard.

In spite of the advantages of the new arrangement, and of the improvements in details successively introduced into the Chanoine system to facilitate raising, and lately for lowering also, the authorities have everywhere begun to place above dams of this system a special service-bridge of trestles of the style invented by M. Poirée. In the latest application of the swinging wickets of M. Chanoine (at the La Mulatière dam at Lyons) Engineer Pasqueau, struck by the necessity of devising a new kind of movable dam which could be used for dams with high lifts and wide passes *without intermediate piers*, devised and applied an entirely novel arrangement by which he could dispense with the tripper. Trippers, as is well known, are complicated pieces of mechanism, which practically limit the free opening between the piers of a dam to a maximum of about 50 meters [164 feet].

This new arrangement of M. Pasqueau, which is very ingenious in its simplicity, consists in resting the props, which hold up the horses of the wickets, against a hurter and slide of a peculiar shape which is fastened to the floor. This slide has two steps—the first supports the foot of the prop when the horse is upright; the other step is oblique and serves to push the prop sideways towards a horizontal groove in which its foot can slide freely to the rear; that is, the prop can lie down. (See *Barrage de la Mulatière, Notice sur le nouveau système des hausses par M. A. Pasqueau, Ingénieur des Ponts et Chaussées. Lyon, imprimerie Pitrat aîné, 1879.*)

The double-stepped hurter of M. Pasqueau, against which rests the prop of the wicket, permits the wicket to be raised, to be swung, and

to be laid down, according to the necessities of the case, by a pull which is always in one direction, and parallel to the thread of the stream.

At the La Mulatière dam a service-bridge of trestles, placed above the rank of wickets, is used in the manœuvres just named.

Without going into a description of the other kinds of movable dams, whose movable parts are likewise provided with horizonral axes of rotation *normal* to the thread of the current, I pass to the system which is probably the most generally adopted at this present, that of M. Poirée.

This system, as is known, consists of a series of trestles whose planes are parallel to the thread of the current. Naturally the axis of rotation, placed at the bottom of these trestles, is likewise parallel to the thread of the current. This axis enables the trestles to turn around journal boxes fastened to the floor. When the series of trestles is upright, and connected at the top to each other and to the abutments, it forms a metallic skeleton, which serves as a support to the true screen or curtain of the dam. This movable screen is either composed of the classic needles of M. Poirée, or of the horizontal gates of the system of M. Boulé. The very simple apparatus for closing, which I have just named, has the immense advantage of transforming the whole length of the dam into an overfall, and it thus permits the adaptation of Poirée trestles to dams with high falls, which could not be done if needles were used.

We see from what precedes that the great difference between movable dams on the Thénard-Mesnager and Chanoine systems, and those which use Poirée trestles, is that, in the first-named dams, the screens, which close the dams with more or less tightness, are fastened to the skeletons themselves, while in the Poirée trestle-dams the skeletons are only used as supports for independent screens, which are raised and carried to shore when the dam is to be opened and laid down.

Being under the necessity of planning a dam for a very wide river (400 meters) [1312 feet], whose floods are very rare and slow, thus always giving time to raise and carry to shore the parts of the movable screen, I thought of applying on this river the system of Poirée trestles with horizontal Boulé gates, modified in conformity with the type used on the river Moskva.

But the use of trestle dams on very wide rivers, where one is obliged to avoid intermediate piers, has many inconveniences. In the first place, as is known, all of the trestles have to be dropped in the same direction. Hence, since this operation can only be begun at one end, it follows that the time required to throw down, or to raise a long dam, would be too great. In the second place, and this is extremely im-

portant, all of the trestles are kept in a vertical position by the movable top-fastenings, which connect them with each other and with the abutments, and the accidental rupture of these fastenings at a single point, during the raising or lowering of the dam, may cause the simultaneous fall of all the trestles. In the third place, the sanding up in a wide river of a considerable length of dam, while the trestles are down, may make it very difficult to erect the dam. Fourthly and lastly, when trestles are used on dams whose lifts are above the average, they have to be quite high, and their thickness is necessarily considerable, and as they lie down with several in a pile, they call for deeper recesses in the floor to contain them. This necessitates an increased thickness of floor, thus augmenting the cost of construction, at the same time that the deeper recess increases the chances of sanding up.

All of these considerations make us think that in practice Poirée trestle dams should no longer be used for pressures exceeding 3 meters [10 feet], and that the lengths of such dams should not exceed from 100 to 150 meters [328 to 492 feet], unless intermediate piers are used.

The beautiful solution devised by Engineer Pasqueau for the La Mulatière dam, which is composed of Chanoine wickets with double-stepped hurters for the props, and a service-bridge above for handling the wickets, has its justification in the local conditions, due to the rapidity of the floods of the Rhone.

I have concluded that, for rivers whose regimens are less torrential, such a solution, which requires a double construction—a dam of wickets and a special service-bridge of trestles—may be replaced by a solution somewhat simpler.

In the new solution, which I offer, I make a complete separation, as is done in dams on the Poirée system, between *the movable screen* (the curtain) and *the skeleton of the dam.*

This skeleton is composed of a series of *horses,* which can fold up and lie down horizontally, parallel to the thread of the stream; or stand upright, supported by their props.

The up-stream standards of a horse are composed of two double T-irons, suitably connected and braced so as to form a rigid frame, upon the up-stream side of which the movable gates are slid into place from above, when the dam is to be closed up after raising.

Each frame has an axis of rotation at its lower end, which passes through journal boxes fastened to the floor.

A second axis, near mid-height of the frame, serves as a hinge for the heads of the props, which hold up the frames after they are raised. The feet of these props rest against double-stepped hurters of the Pasqueau system.

The width of the frame forming the up-stream face of each horse depends on the width to be given to the gates. As a rule this width will be the same as the distance between the trestles of the ordinary trestle-dam. The distance between the adjacent standards of two consecutive horses should be the same as the distance between the standards of the same horse, in order that the closing gates may rest indiscriminately, either against the standards of the same horse, or against the standards of two consecutive horses.

From what precedes it will be seen that each chief standard with its prop forms a kind of trestle, that can fold up and lie down horizontally parallel to the thread of the stream. In order to compel these folding trestles to always keep in the same vertical plane, parallel to the current, while they are being raised or lowered, we connect them two by two, as has already been said, both by means of the axes, which serve as hinges, and by the braces that hold together the two principal up-stream standards.

It is also practicable to add to the rigidity of the system by partly bracing together the two props of the same horse.

Below the front rank of principal frames there is placed a second rank of very light frames similar to the first, and connected with the latter on top by cross-pieces parallel to the thread of the stream. These two frames, thus connected by cross-pieces, having axes of rotation at the points of intersection, form, in the vertical plane parallel to the current, two movable parallelograms which can fall down stream and lie horizontally on the floor.

When the system which has just been described is upright, supported by the props, each horse forms a skeleton, which can serve both as a service-bridge for placing and manœuvring the gates, and also as a support against the pressure of these gates.

The operation of raising a dam composed of such horses is performed as follows:

On a small railroad on the abutment there is a rolling crane, suitably weighted, having an adjustable boom. This crane, which is worked by hand, begins by raising the first horse, which is lying on the floor at a distance from the bank equal to its width; as soon as the feet of the props are heard to fall into their seats, the crane ceases to raise, two balks are placed from the abutment to the cross-pieces of this first horse, on these is laid the flooring of the service-bridge, and then the crane is run forward on this first piece of dam. From this point the second horse is raised and the second piece of dam is erected, and so on to the end.

When once all of the horses have been raised, the horizontal gates are brought up on trucks and are put in place by hand, as is done on a trestle-dam.

To perform the reverse operation, that is, to lower the dam, we begin by lifting and removing all the gates by hand with the aid of boat-hooks, and with the same crane we raise slightly the horse, which we wish to lower, until the prop falls off of the sliding step; then the crane lowers the horse and its accessories to the floor. During this operation the crane travels backward, until it reaches the abutment whence it began the operation of raising.

From this concise description, which shows the idea which guided us in proposing the kind of dam of which we are speaking, the advantages of using it can be deduced. They are as follows:

1. By this system a dam of any length whatever can be built without intermediate piers.

2. A dam of this kind gives a surface overflow along its whole length, and it is exactly as water-tight as a trestle-dam with Boulé gates.

3. The operations of raising and lowering a dam of this kind can be begun simultaneously from the two abutments by means of two different cranes, and it is even possible, if greater speed is desired, to raise the horses by means of boats equipped with light shears.

4. Should the dam be sanded up at one or at several places, the raising of the horses is not hindered, since it is practicable to raise at will any of the parts of the dam which are not covered, and by increasing the current over the sanded parts, they are rapidly cleaned off.

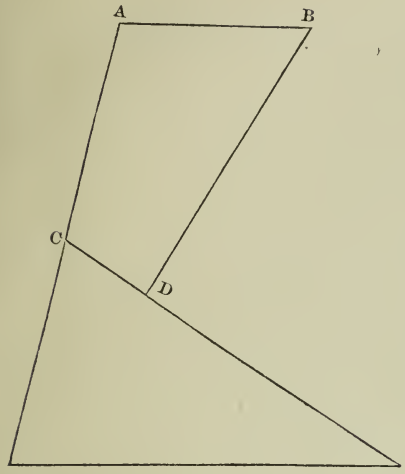
5. Since in our style of dam the skeleton serves also as a service-bridge, this style must necessarily be cheaper than those in which it is necessary to place above the true dam a special service-bridge. For the same reason the operations of raising and lowering such dams are more rapid.

6. The kind of dam just described can be used for the greatest lifts without inconvenience.

Whilst we were engaged in elaborating the details of the type described above, one of our colleagues, M. Gouschkofsky, Engineer in the Russian Corps of *Ponts et Chaussées*, conceived the idea of the following additional modification. In the combination described, the rear frame, which has no other use than to support the cross-pieces of the foot-bridge, instead of having its points of rotation low down on the floor, might have had them on the props themselves.

In order that a horse, thus modified, may be able to lie down horizontally, and to fold up into one plane, as happens in the case of

the parallelogram of our system described above, the two points of rotation A and D, of the quadrilateral which forms the skeleton of the service-bridge, must lie on the circumference of an ellipse, of which the two other points, B and C, are the foci. M. Gouschkofsky proposed, in addition, to sustain the feet of props, not in a Pasqueau hurter, but in a seat, open on top, and fastened to the floor, into which the feet of the two props, joined below into one, would fall automatically when the dam was raised. To lower such a horse, the foot of the prop would have to be lifted out of the seat by a special chain. Without agreeing as to the advantages of this last detail, I highly approve of the modification, proposed by M. Gouschkofsky, of placing the point of rotation of the bars that support the service-bridge on the props, instead of having them on the floor. We can thus lessen the weight of metal in the folding trestles, which make the skeleton of this dam, and can reduce to *one*, that is to say, to the minimum, the nunber of points of fastening and of rotation on the floor.



It is well known that, in any system, the less there is of mechanism under water, the less danger there is of derangement; and on the other hand the greater the facility of repair in case of necessity.

To sum up, the kind of movable dam with horses, which we have just described, and which is shown more in detail on the annexed drawing, borrows its simplicity from Thénard system, avoids the construction of a special service-bridge, which is necessary with the Chanoine system, and whilst preserving the same advantages as the Poirée trestle-system, avoids the inconveniences of those trestles. We believe that this system is specially adapted to very wide rivers with movable bottoms, where it is desirable to avoid the construction of intermediate piers.

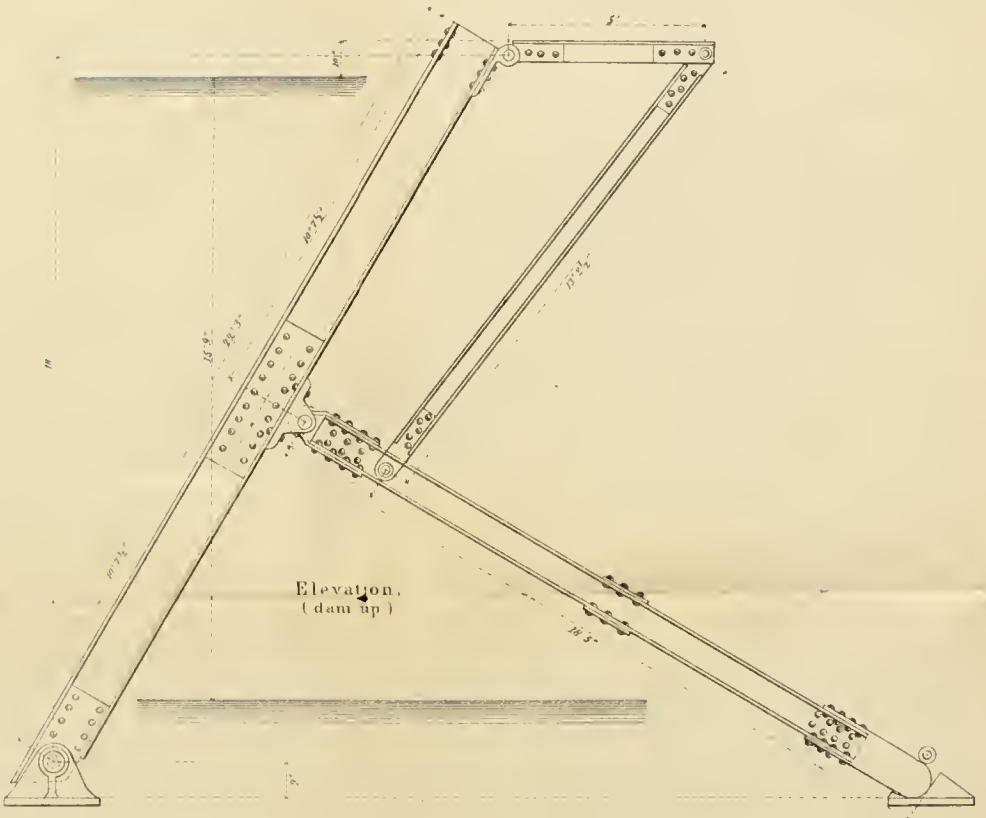
S. Janicki.

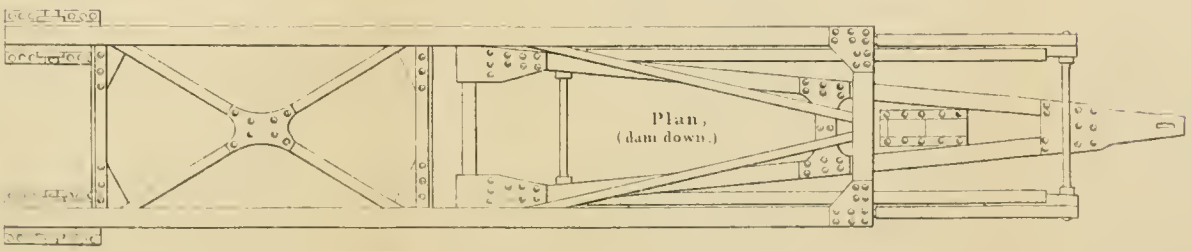
Moscow, $\frac{\text{June 23,}}{\text{July 5,}}$ *1882.*

MOVABLE DAM,

Designed by Janicki,

with modifications by Gouschkofsky, Ingr. des P.et C. de Russie.

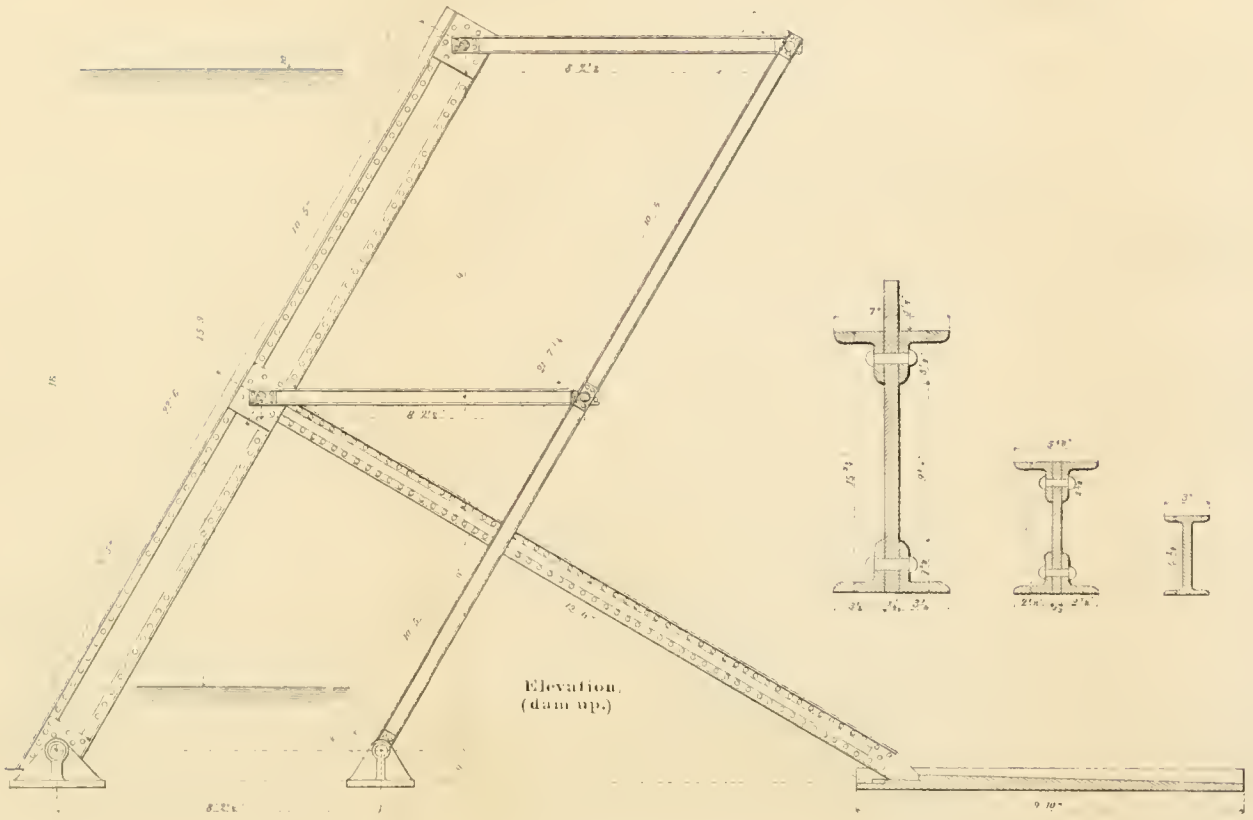


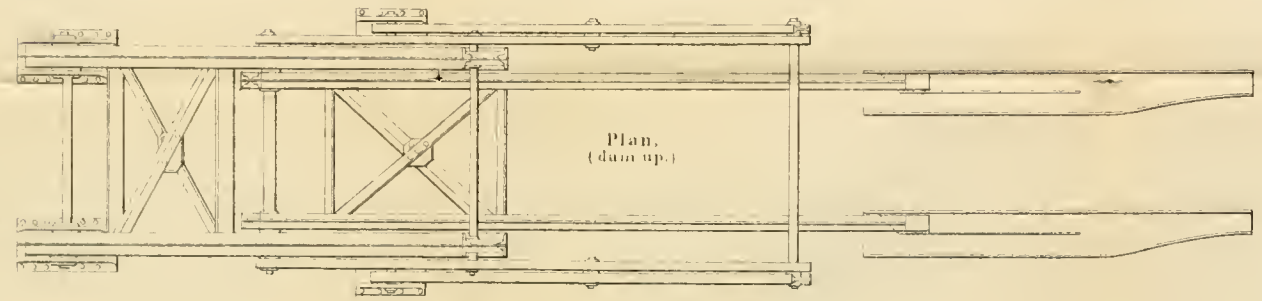


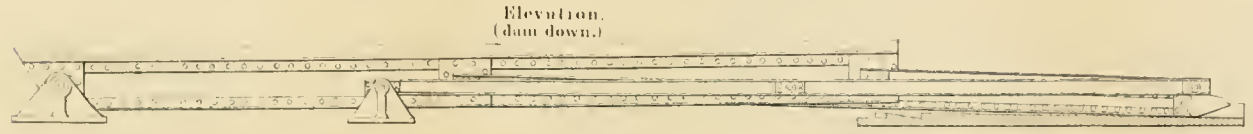
MOVABLE DAM.

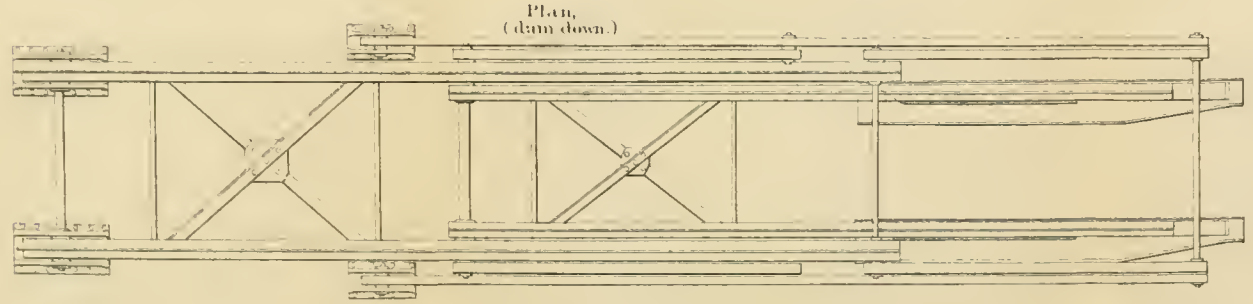
Designed by S. Janicki,

Managing Director, Moskva Navigation Co. of Russia.









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